

MAPPING MINNEAPOLIS URBAN TREE CANOPY

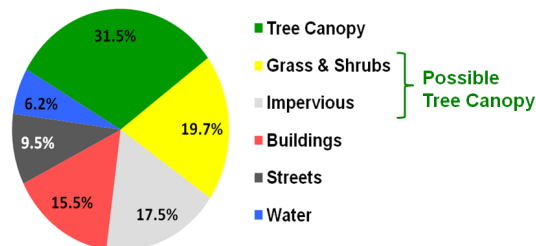


Why is Tree Canopy Important?

Trees are an important component of urban environments. In addition to their aesthetic value, trees have significant economic and environmental benefits, including: reducing stormwater runoff, energy conservation, improving air quality, and enhancement of community vitality, stability and property values for residential and business areas. An urban tree cover (UTC) assessment that estimates the amount of tree canopy currently present (Existing UTC), along with the amount of tree canopy that could potentially be established (Possible UTC), is the first step in the UTC goal-setting process. Analysis and classification of remote sensing imagery, along with geographic information system (GIS) analysis and modeling, provide the most efficient method for assessment.

Mapping Minneapolis Urban Tree Canopy

A land cover classification (Figure 1) of Minneapolis with overall accuracy of 92% was generated using a combination of high resolution (0.6-meter) multispectral satellite imagery and lidar data. Lidar with its information on tree height was especially useful.



The City was covered by Existing tree canopies of 31.5% (11,569 acres) in 2009. Trees could potentially, under the right circumstances, cover an additional 37.5% (13,684 acres); termed Possible UTC, these areas include grass and impervious surfaces (e.g., parking lots). The remaining 31% (11,479 acres) of the City's area of buildings, streets, water and other permanent features is generally unsuited to UTC improvement. Many factors determine where and when trees are planted and maintained, but a UTC assessment is an essential first step of determining where trees can be planted if the requisite social-political and financial capital exists.

Key Terms

Land Cover: Physical features mapped from aerial or satellite imagery such as trees, grass, impervious surfaces and water.

Urban Tree Canopy: The layer of leaves, branches and stems of trees that cover the ground when viewed from above.

Existing UTC: Land presently covered by trees.

Possible UTC: Areas with grass or impervious surface where it is theoretically possible to plant trees (i.e., excludes Existing tree canopy, streets, buildings and water) .

Project Background

The analysis of Minneapolis urban tree canopy was carried out as part of a grant to Minneapolis from the Minnesota Department of Natural Resources Metro Greenways program. The analysis was performed by the University of Minnesota's Remote Sensing and Geospatial Analysis Laboratory. The goal of the project was to apply the USDA Forest Service UTC assessment protocol to Minneapolis.

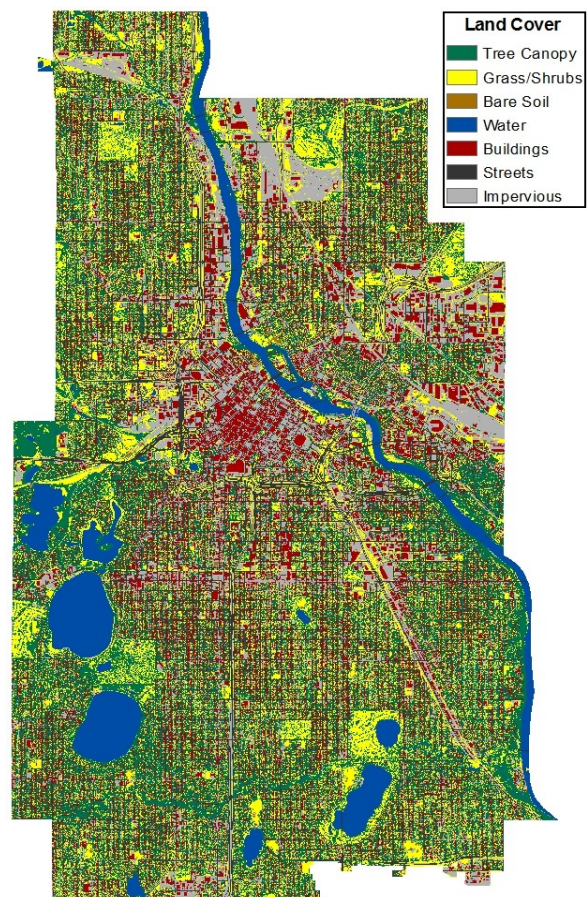


Figure 1. Land cover classification of Minneapolis.



Figure 2. Enlargement of a portion of the classification.

Analysis of Parcels

The detailed land cover mapping conducted as part of this assessment permitted calculation of the percentage of Existing and Possible UTC for each parcel of land in Minneapolis (Figure 3). This information provides a comprehensive overview of the existing tree canopy on each ownership unit and is an essential first step in answering: Where are the city's trees? It also provides the corollary analysis that is a necessary prerequisite to prioritization: Where are the areas that could potentially support expanded tree canopy?

These parcel-based estimates were then combined with land use data to examine patterns of parcels and land use zoning (Figures 4 and 5 and Table 1). Much of Minneapolis tree canopy occurs in publically owned parks and recreation zones. However, residential zones also contain a significant proportion of Existing tree cover. Interestingly, most of the land suitable for expanded tree canopy is also in residential zones.

The insights derived from these analyses results in an understanding of citywide ownership patterns and a database of parcels where tree planting might be beneficial that can be used to prioritize neighborhoods for UTC improvement programs and then target specific properties on which more trees are logistically feasible and socially desirable. Actual prioritization efforts will depend on many factors, but an accurate assessment of current UTC conditions is the baseline from which all subsequent analyses will be developed.

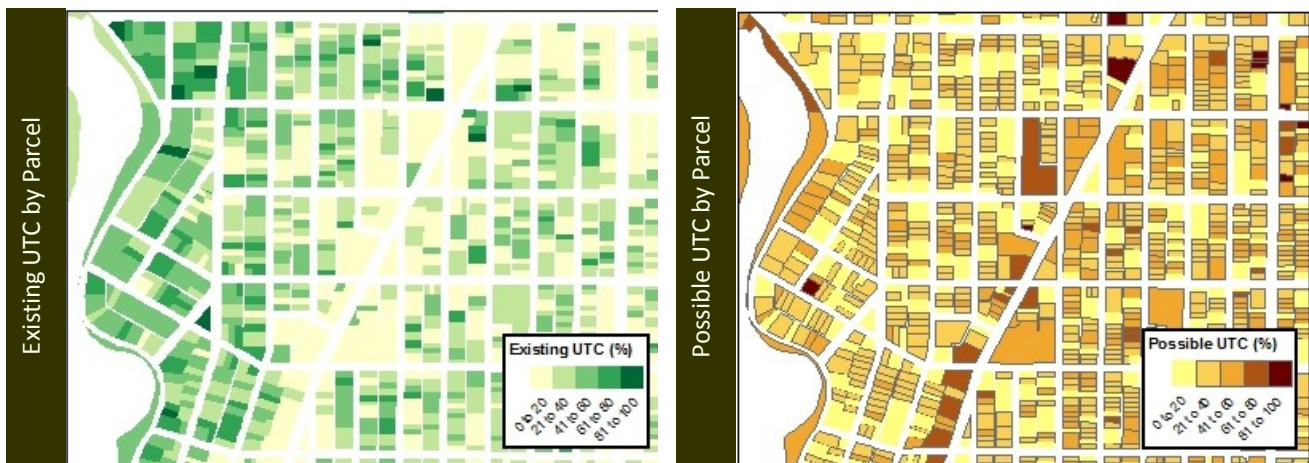


Figure 3. Distribution of Existing and Possible urban tree canopy in parcels near Lake of the Isles.

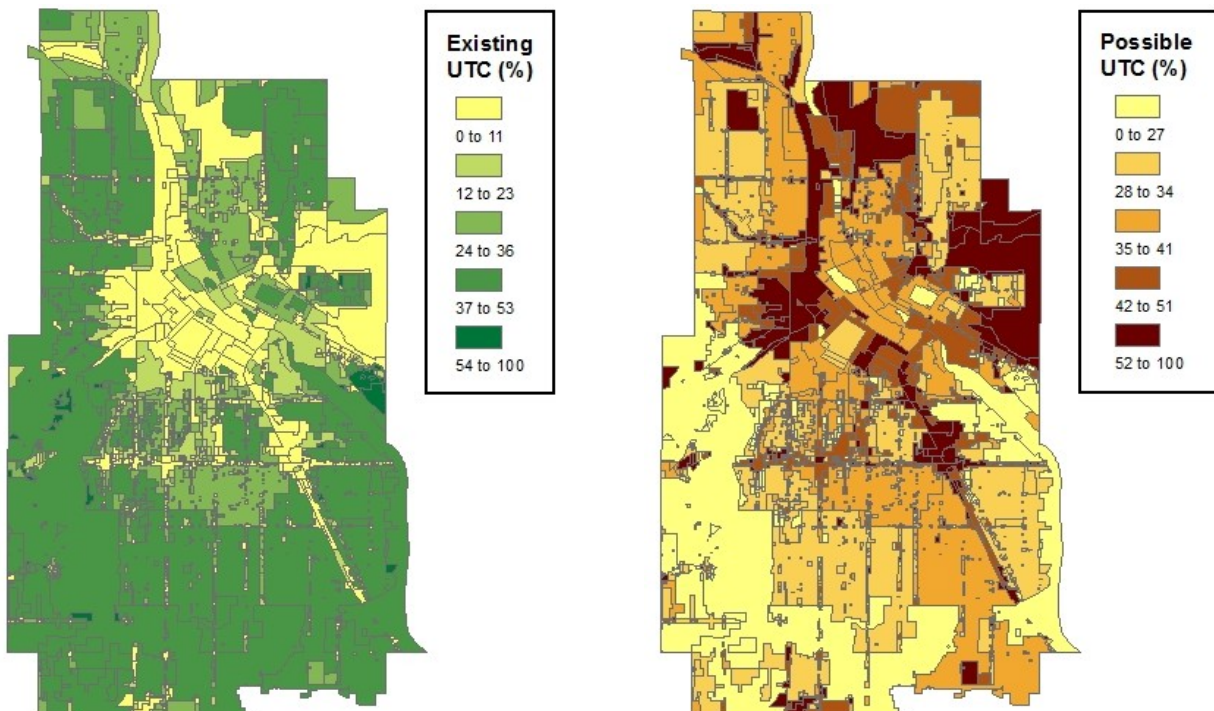


Figure 4. Distribution of Existing and Possible urban tree canopy in Minneapolis land use zoning districts.

Analysis of Land Use Patterns

With a high resolution classification of the entire City, the maps and statistics can be summarized and examined for a variety of other categories such as the land use data provided by the City (Figure 5). The results show that the highest amounts of Existing and Possible tree cover are in residential areas. Most of the Possible tree cover in commercial, downtown and community centers is in the currently impervious areas such as parking lots.

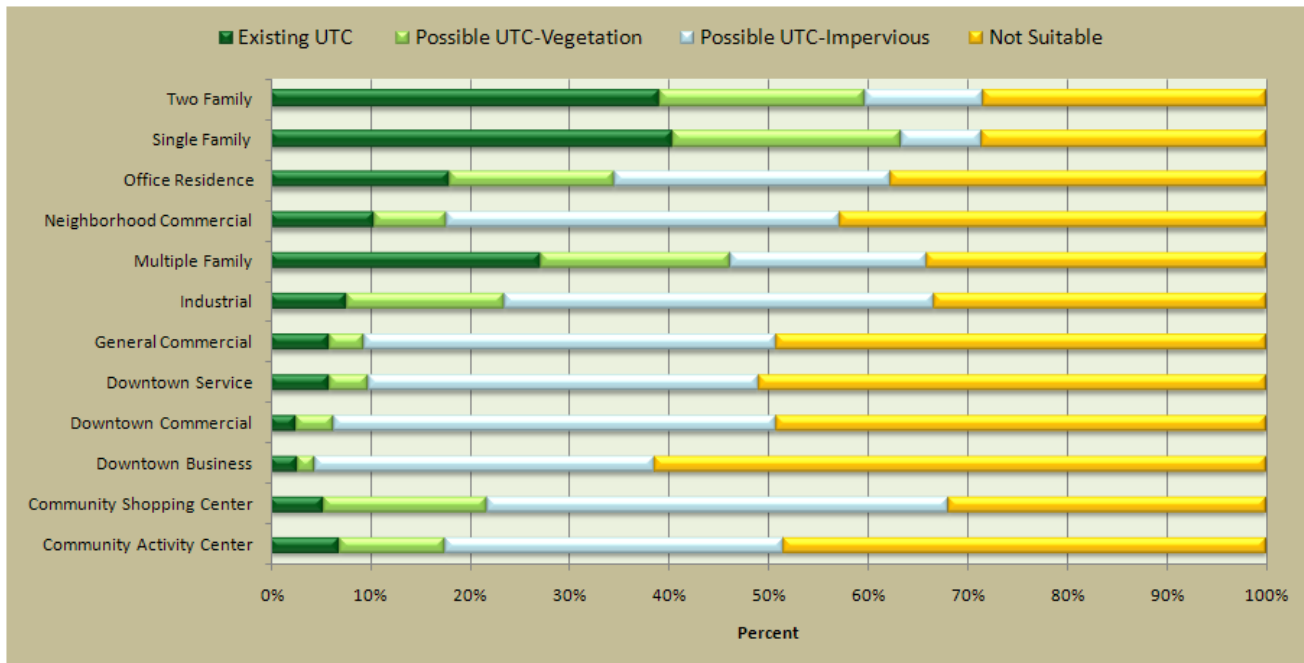


Figure 5. UTC metrics summarized by land use. Note that park land is included in the other land use categories.

Table 1. UTC metrics summarized by land use. For each land use category, UTC metrics were computed as a percent of all land in the city (%Land), as a percent of land area by land use category (% Category), and as a percent of the area for the UTC type (%UTC Type).

| Land Use | Existing UTC | | | Possible UTC Vegetation | | | Possible UTC Impervious | | |
|---------------------------|--------------|-----------|-----------|-------------------------|-----------|-----------|-------------------------|-----------|-----------|
| | %Land | %Category | %UTC Type | %Land | %Category | %UTC Type | %Land | %Category | %UTC Type |
| Community Activity Center | 0% | 7% | 0% | 0% | 11% | 1% | 0% | 34% | 3% |
| Community Shopping Center | 0% | 5% | 0% | 0% | 16% | 0% | 0% | 46% | 1% |
| Downtown Business | 0% | 3% | 0% | 0% | 2% | 0% | 0% | 34% | 1% |
| Downtown Commercial | 0% | 3% | 0% | 0% | 4% | 0% | 0% | 44% | 1% |
| Downtown Service | 0% | 6% | 0% | 0% | 4% | 0% | 0% | 39% | 2% |
| General Commercial | 0% | 6% | 0% | 0% | 3% | 0% | 0% | 41% | 0% |
| Industrial | 1% | 8% | 3% | 2% | 16% | 11% | 6% | 43% | 34% |
| Multiple Family | 2% | 27% | 7% | 2% | 19% | 8% | 2% | 20% | 9% |
| Neighborhood Commercial | 0% | 10% | 1% | 0% | 7% | 1% | 1% | 40% | 7% |
| Office Residence | 1% | 18% | 2% | 1% | 16% | 3% | 1% | 28% | 6% |
| Single Family | 21% | 40% | 68% | 12% | 23% | 61% | 4% | 8% | 25% |
| Two Family | 6% | 39% | 18% | 3% | 21% | 15% | 2% | 12% | 10% |

$$\% \text{ Land} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land}}$$

$$\% \text{ Category} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land for specified land use}}$$

$$\% \text{ UTC Type} = \frac{\text{Area of UTC type for specified land use}}{\text{Area of all land for specified UTC type}}$$

The % Land value of **21%** indicates that 21% of Minneapolis land is tree canopy in the areas where land use is 'Single Family'.

The % Category value of **40%** indicates that 40% of 'Single Family' land is covered by tree canopy.

The % UTC Type value of **68%** indicates that 68% of all Existing UTC lies in the 'Single Family' land use.

Analysis of Neighborhoods

Another example of potential analyses is to examine neighborhood patterns. Their finer scale and more numerous units produce a broader distribution of tree canopy cover (Figure 6). Neighborhoods encompassing all or parts of parks like Minnehaha and along the Mississippi River in the southeast include large total areas and proportions of Existing UTC, while those in and near the city center contain less (Figure 7). Neighborhoods which include the City's lakes (e.g., 41, 42, 46, 49, 69, 70, 72, 73) will tend to have a lower Possible UTC since this land cover type is not suitable for UTC expansion. Neighborhoods with the highest proportions of Possible UTC include industrial areas in the north directly east of the Mississippi River and northeast of downtown neighborhoods along the western edge of the Mississippi River.

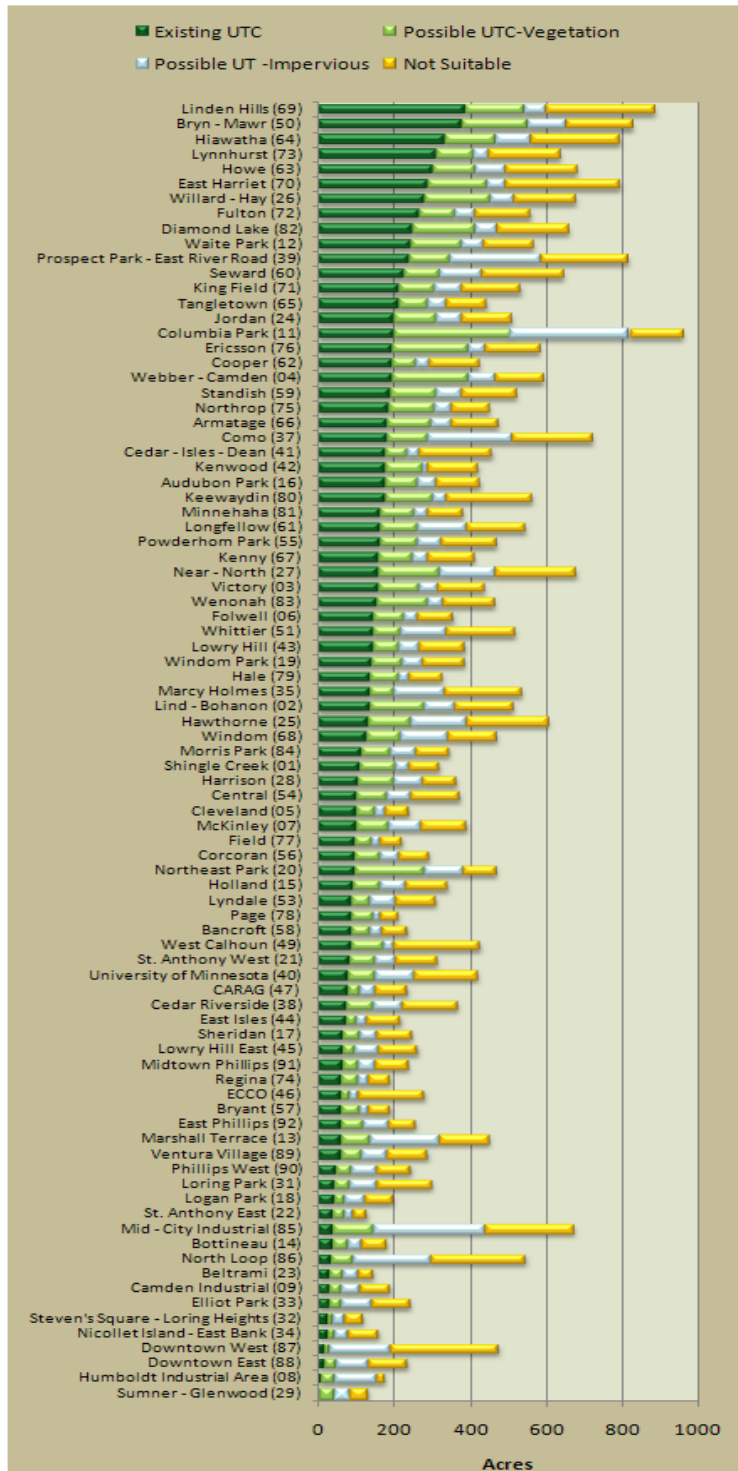


Figure 6. Distribution of Existing and Possible UTC in Minneapolis neighborhoods.

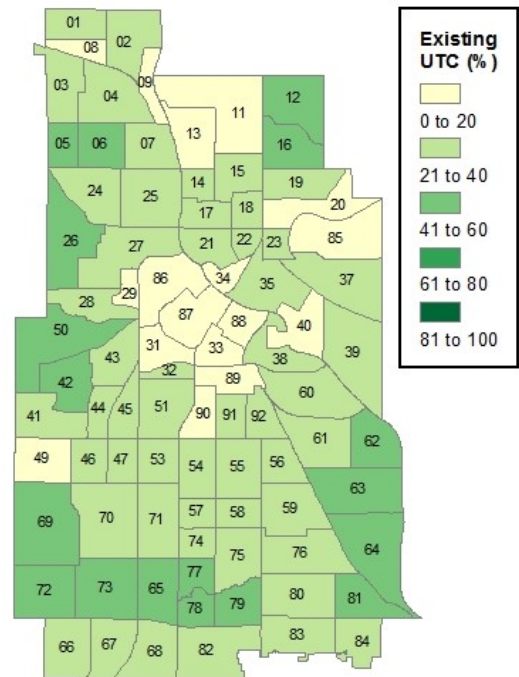


Figure 7. Existing UTC as percent of land area for Neighborhoods.

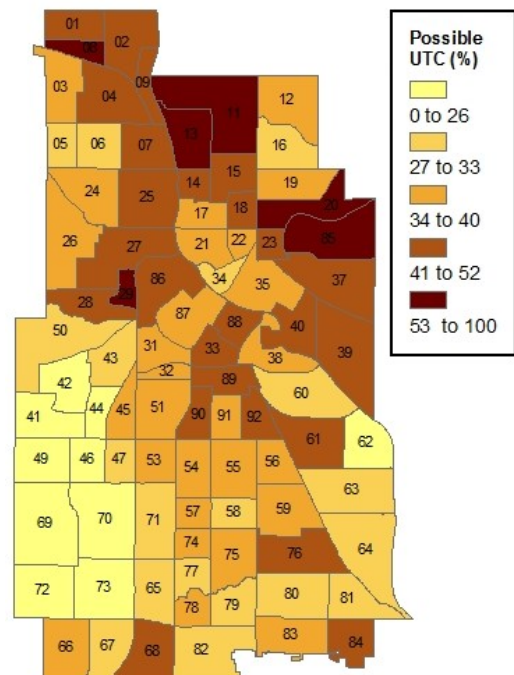


Figure 8. Possible UTC as the percent of land area for Neighborhoods.

Where to Plant Trees?

The GIS database can be used to identify specific UTC metrics for a parcel, a neighborhood, or other area of interest. This information can be used to estimate the amount of Possible tree loss in a planned development or to set UTC improvement goals for individual properties.

| Attribute | Value |
|--------------------------|----------------------|
| Land Use: | Commercial |
| Owner: | School District No 1 |
| Address: | 807 N E Broadway |
| Existing UTC: | 5% |
| Possible UTC: | 49% |
| Possible UTC-Vegetation: | 27% |
| Possible UTC-Impervious: | 22% |

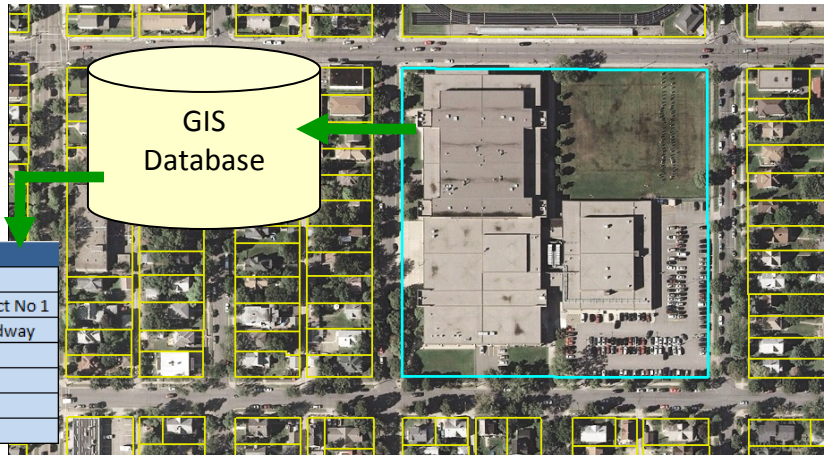


Figure 6. Example of parcel-based metrics to support UTC analysis.

Summary and Conclusions

- Minneapolis trees are an important asset of the City, providing many environmental, socio-economic and aesthetic benefits.
- High resolution remote sensing data were classified into land cover classes of tree canopy, grass and shrubs, bare soil, water, buildings, streets, and other impervious. The classification maps and statistical data are available in a GIS database and a web-based mapping application for further analysis by the City in setting goals and planning for tree planting and maintenance.
- The overall tree canopy cover of the City in 2009 was 11,569 acres or 31.5%.
- Single family, two family, and multiple family housing represent 93% of the Existing tree canopy of the City.
- Single and two family residences contain about 40% of their land cover as tree canopy. They also represent 76% of the Possible vegetation UTC sites.
- Industrial land use categories also represent high potential for Possible UTC, both in vegetated (11%) and impervious (34%) land cover areas.
- Neighborhood analysis utilizing the Existing and Possible UTC summaries can be used to help target tree canopy improvement and preservation activities. Parcels with low Existing UTC and high Possible UTC within neighborhoods can be selected within the parcel database and be examined in more detail.
- The parcel database with its percent tree canopy and other land cover data can be used in conjunction with other targeting efforts to identify parcels and areas, including open right of ways, for planting additional trees.
- In summary, the maps provide essential data for planning for the future of a vital Minneapolis asset – its tree canopy.

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Additional Information

More information on urban tree canopy assessment can be found at: <http://nrs.fs.fed.us/urban/utc/>.